WHAT IS CLAIMED IS:

1. A projection optical system capable of projecting to an image space an image of an object in an object space, the system comprising:

a) at least one first refractive optical member comprising a first fluoride substance; and

b) at least one second refractive optical member comprising a second fluoride substance;

c) wherein MX_1 is greater than MX_2; and

d) the design condition $0.4 < \frac{MX_2}{MX_1} < 0.87$ is satisfied;

e) where MX_1 is the effective aperture of the surface or surfaces having the largest effective aperture among the surface or surfaces of the first refractive optical member or members; and

f) MX_2 is the effective aperture of the surface or surfaces having the largest effective aperture among the surface or surfaces of the second refractive optical member or members.

2. A projection optical system according to claim 1 wherein:

a) the first fluoride substance is calcium fluoride; and

b) the second fluoride substance is barium fluoride.

3. A projection optical system according to claim 2 furthermore comprising:

a) at least one positive lens component; and

b) at least one negative lens component;

c) wherein at least one of the positive lens component or components comprises the first fluoride substance; and

d) at least one of the negative lens component or components comprises the second fluoride substance.

4. A projection optical system according to claim 3 wherein each of the lens components of the projection optical system respectively consists of only the first fluoride substance or the second fluoride substance or both.

5. A projection optical system according to claim 4 wherein the *f*-number of the second refractive optical member or the respective *f*-numbers of each of the second refractive optical members satisfies or satisfy the design condition $0.8 < |FN_i|$, where FN_i represents each such *f*-number.

6. A projection optical system according to claim 1 furthermore comprising:

a) at least one positive lens component; and

b) at least one negative lens component;

c) wherein at least one of the positive lens component or components comprises the first fluoride

substance; and

d) at least one of the negative lens component or components comprises the second fluoride substance.

7. A projection optical system according to claim 1 wherein each of the lens components of the projection optical system respectively consists of only the first fluoride substance or the second fluoride substance or both.

8. A projection optical system according to claim 1 wherein the *f*-number of the second refractive optical member or the respective *f*-numbers of each of the second refractive optical members satisfies or satisfy the design condition $0.8 < |FN_i|$, where FN_i represents each such *f*-number.

9. An exposure apparatus capable of transferring onto a substrate an image of a pattern on a mask, the apparatus comprising:

a) a light source capable of supplying radiation for exposure;

b) an illumination optical system arranged to receive at least some of the radiation from the light source and guide at least some of the received radiation to the mask; and

c) a projection optical system according to claim 1;

d) wherein the mask is capable of being disposed

in the object space; and

e) the substrate is capable of being disposed in the image space.

10. An exposure apparatus capable of transferring onto a substrate an image of a pattern on a mask, the apparatus comprising:

a) a light source capable of supplying radiation for exposure;

b) an illumination optical system arranged to receive at least some of the radiation from the light source and guide at least some of the received radiation to the mask; and

c) a projection optical system capable of forming on the substrate an image of the pattern on the mask in correspondence to radiation received from the mask;

d) wherein the projection optical system comprises one or more refractive optical members collectively comprising at least two fluoride substances; and

e) a linewidth of the radiation from the light source is narrower than a natural linewidth thereof.

11. A projection exposure apparatus according to claim 10 wherein each of the refractive optical members within the projection optical system respectively comprises one or more fluoride substances.

12. A projection exposure apparatus according to claim 11 wherein the at least two fluoride substances collectively include calcium fluoride and barium fluoride.

13. A projection exposure apparatus according to claim 12 wherein:

a) the at least two fluoride substances collectively include a first fluoride substance and a second fluoride substance which are such that:

b) MX_1 is greater than MX_2; and

c) the design condition $0.4 < \frac{MX_2}{MX_1} < 0.87$ is satisfied;

d) where MX_1 is the effective aperture of the surface or surfaces having the largest effective aperture among the surface or surfaces of the refractive optical member or members comprising the first fluoride substance; and

e) MX_2 is the effective aperture of the surface or surfaces having the largest effective aperture among the surface or surfaces of the refractive optical member or members comprising the second fluoride substance.

14. A projection exposure apparatus according to claim 13 wherein the projection optical system furthermore comprises:

a) at least one positive lens component; and

b) at least one negative lens component;

c) wherein at least one of the positive lens component or components comprises the first fluoride substance; and

d) at least one of the negative lens component or components comprises the second fluoride substance.

15. A projection exposure apparatus according to claim 14 wherein:

a) the at least two fluoride substances collectively include a first fluoride substance and a second fluoride substance; and

b) the *f*-number or the respective *f*-numbers of the refractive optical member or members comprising the second fluoride substance satisfies or satisfy the design condition $0.8 < |FN_i|$;

c) where FN_i represents each such *f*-number.

16. A projection exposure apparatus according to claim 15 wherein a linewidth of the radiation from the light source is not more than half of a natural linewidth thereof as measured on a full-width-at-half-maximum basis.

17. A projection exposure apparatus according to claim 16 wherein the light source comprises an F_2 laser.

18. A projection exposure apparatus according to claim 17 wherein the light source comprises:

a) an oscillator capable of generating radiation having a linewidth narrower than a natural linewidth thereof; and

b) an amplifier capable of amplifying the output of the radiation generated by the oscillator.

19. A projection exposure apparatus according to claim 18 wherein a linewidth of the radiation supplied by the light source is not more than 0.3 pm as measured on a full-width-at-half-maximum basis.

20. A projection exposure apparatus according to claim 19 wherein the at least two fluoride substances collectively include two species selected from among the group consisting of calcium fluoride, barium fluoride, lithium fluoride, magnesium fluoride, strontium fluoride, lithium calcium aluminum fluoride, and lithium strontium aluminum fluoride.

21. A projection exposure apparatus according to claim 10 wherein the at least two fluoride substances collectively include calcium fluoride and barium fluoride.

22. A projection exposure apparatus according to claim 10 wherein:

a) the at least two fluoride substances collectively comprise a first fluoride substance and a second fluoride substance which are such that MX_1 is greater than MX_2; and

b) the design condition $0.4 < \frac{MX_2}{MX_1} < 0.87$ is satisfied;

c) where MX_1 is the effective aperture of the surface or surfaces having the largest effective aperture among the surface or surfaces of the refractive optical member or members comprising the first fluoride substance; and

d) MX_2 is the effective aperture of the surface or surfaces having the largest effective aperture among the surface or surfaces of the refractive optical member or members comprising the second fluoride substance.

23. A projection exposure apparatus according to claim 10 wherein:

a) the at least two fluoride substances include a first fluoride substance and a second fluoride substance; and

b) the *f*-number or the respective *f*-numbers of the refractive optical member or members comprising the second fluoride substance satisfies or satisfy the design condition $0.8 < |FN_i|$;

c) where FN_i represents each such *f*-number.

24. A projection exposure apparatus according to claim 10 wherein a linewidth of the radiation from the light source is not more than half of a natural linewidth

thereof as measured on a full-width-at-half-maximum basis.

25. A projection exposure apparatus according to claim 10 wherein the light source comprises an F_2 laser.

26. A projection exposure apparatus according to claim 10 wherein the light source comprises:

a) an oscillator capable of generating radiation having a linewidth narrower than a natural linewidth thereof; and

b) an amplifier capable of amplifying the output of the radiation generated by the oscillator.

27. A projection exposure apparatus according to claim 10 wherein a linewidth of the radiation supplied by the light source is not more than 0.3 pm as measured on a full-width-at-half-maximum basis.

28. A projection exposure apparatus according to claim 10 wherein the at least two fluoride substances include two species selected from among the group consisting of calcium fluoride, barium fluoride, lithium fluoride, magnesium fluoride, strontium fluoride, lithium calcium aluminum fluoride, and lithium strontium aluminum fluoride.

29. A projection exposure method for transferring onto a substrate an image of a pattern on a mask, the method comprising:

a) readying the mask for exposure;

b) readying the substrate for exposure; and

c) using a projection exposure apparatus according to claim 9 to form on the substrate an image of the pattern on the mask.

30. A projection exposure method for transferring onto a substrate an image of a pattern on a mask, the method comprising:

a) readying the mask for exposure;

b) readying the substrate for exposure; and

c) using a projection exposure apparatus according to claim 10 to form on the substrate an image of the pattern on the mask.